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THE ACTION OF TAKA-DIASTASE
IN VARIOUS GASTRIC DISORDERS.

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THE ACTION OF TAKA-DIASTASE IN VARIOUS GASTRIC DISORDERS.

*AN EXPERIMENTAL STUDY.**

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SINCE taka-diastase has been introduced into medicine and its amylolytic action has been demonstrated, this remedy has been employed in various forms of gastric disorder. After the first trials the indications for the use of drugs become more and more limited and exact until, having been thoroughly tested, they are clear and well defined; so with taka-diastase. The great difficulty in determining the exact indication for the use of most medicaments does not apply to the artificial ferments in their applicability to gastric disorders, for their action can be tested not only in the test tube, but experiments may be made directly with the gastric juice both within the stomach and outside the body.

The amylolytic action of taka-diastase has been settled beyond all doubt. This substance, under proper conditions, converts one hundred times its weight of starch in ten minutes. But, though this has been established by numerous experimenters, the therapeutic indications for its use are still ill-defined, for no one has as yet tested the action of taka-diastase upon digestion within the stomach itself.

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It has generally been stated that taka-diastase is indicated in amylaceous dyspepsia, but this term is vague, and signifies a symptomatic condition and not a definite disorder. In order to clearly define the indication for the use of taka-diastase the following experiments were performed.

A test-breakfast was taken, and the contents of the stomach removed after an hour; after washing out the stomach a similar breakfast, to which two and a half grains of taka-diastase had been added, was swallowed, and also removed after the end of an hour. Comparisons were made in the two instances.

The test-breakfast utilized in the experiment consisted of the ordinary Ewald test-breakfast, forty grammes of white bread and three hundred cubic centimetres of water. In the second series two and a half grains of taka-diastase were added to such a meal. In both instances the contents of the stomach were completely removed at intervals of sixty, forty, twenty, and ten minutes.

The character, quantity, and temperature of both breakfasts were always the same in those cases in which comparisons were made. Complete expression of the gastric contents was made in all instances; the quantity thus obtained is in a measure an index of the motor activity

TABLE I.—*Normal Cases.*

Name.	No.	Test break- fast.	Time re- served, seconds.	Quantity removed in c. c.	Congo reac- tion	Phloro- glucin- vanillin.	Iodine reac- tion.	Tot'l acid- ity.	Per cent. HCl.
J. J.	1	Ewald.	60	40	Yes.	Yes.	Violet.	58	0·1732
	2	Ewald.	40	85	Yes.	Yes.	Blue.	36	0·1327
	3	Ewald.	20	190	No.	No.	Blue.	30	0·1096
	4	Ewald.	10	220	No.	No.	Blue.	14	0·0132
	5	Ewald + 2½ gr. T. D.	60	37	Yes.	Yes.	Violet.	60	0·1659
	6	Ewald + 2½ gr. T. D.	40	80	Yes.	Yes.	Blue.	35	0·1426
	7	Ewald + 2½ gr. T. D.	20	140	No.	No.	Blue.	27	0·1084
	8	Ewald + 2½ gr. T. D.	10	200	No.	No.	Blue.	16	0·0144

of the stomach. The gastric filtrate was tested with litmus, Congo paper, phloroglucin vanillin (for free hydrochloric acid). The total acidity was estimated with one

tenth normal NaOH solution, phenolphthalein being used as an indicator, and the hydrochloric acid determined by Boas's modification of the Sjöquist method. The experiments were made upon persons with perfectly normal digestion (Table I) and cases of nervous dyspepsia with normal motor and secretory functions (Table II). Tables I and II show—

1. Names of experiments.
2. Number of experiments.
3. Test-breakfast utilized; Ewald representing Ewald test-breakfast; T. D. representing two grains and a half of taka-diastase.

TABLE II.—*Cases of Nervous Dyspepsia, with Normal Secretory and Motor Functions.*

Name.	No.	Test break- fast.	Time re- moved, minutes.	Quan- tity in c. c.	Congo reac- tion.	Phloro- glucin. vanillin.	Iodine reac- tion.	Tot'l acid- ity.	Per cent. HCl.
F. K.	1	Ewald.	60	50	Yes.	Yes.	Violet.	64	0·1692
	2	Ewald.	20	110	No.	No.	Blue.	28	0·1012
	3	Ewald + T. D.	60	54	Yes.	Yes.	Violet.	60	0·1641
	4	Ewald + T. D.	20	100	No.	No.	Blue.	31	0·1084
T. P.	1	Ewald.	60	56	Yes.	Yes.	Violet.	54	0·1821
	2	Ewald.	20	130	No.	No.	Blue.	21	0·0641
	3	Ewald + T. D.	60	50	Yes.	Yes.	Violet.	57	0·1817
	4	Ewald + T. D.	20	120	No.	No.	Blue.	20	0·0592
J. M.	1	Ewald.	60	48	Yes.	Yes.	Violet.	62	0·1742
	2	Ewald.	20	178	No.	No.	Blue.	24	0·0781
	3	Ewald + T. D.	60	50	Yes.	Yes.	Violet.	58	0·1717
	4	Ewald + T. D.	20	164	No.	No.	Blue.	26	0·0629

4. Time removed.
5. Quantity obtained.
6. Reaction obtained with Congo paper.
7. Reaction for free hydrochloric acid with phloroglucin vanillin.
8. Reaction for starch and erythrodextrin with Lugol's solution.
9. Acidity as determined by means of one tenth Na OH solution, phenolphthalein being used as indicator.
10. Hydrochloric acid as determined by Sjöquist's method.

The gastric contents expressed were about the same in quantity in both instances in which the taka-diastase had

been taken with the test-breakfast and in those in which it had not been. The total acidity and percentage of hydrochloric acid was also about the same.

Thus, in Table I, case J. J., when the breakfast was expressed at the end of sixty minutes the quantity removed was about the same (forty cubic centimetres and thirty-seven cubic centimetres), the percentage of hydrochloric acid was likewise the same in amount (0.17 and 0.16) as when taka-diastase had been added to the breakfast. Similarly, in Table II, case F. K., a case of nervous dyspepsia with normal motor and secretory functions, the quantities of contents obtained at the end of sixty minutes were fifty cubic centimetres and fifty-four cubic centimetres; the percentage of hydrochloric acid, 0.16 and 0.16; the digestion of starches was the same in both instances. Taka-diastase therefore produces no change upon either the motor or secretory functions of the stomach under normal conditions, or in cases of nervous dyspepsia with normal motor and secretory functions, nor is the digestion of starches affected by it.

TABLE III.—*Cases of Normal Secretory Function, with Decreased Motor Function (Atony).*

Name.	No.	Test break- fast.	Time in minutes.	Quantity removed in c. c.	Congo reaction.	Phloro- glucin vanillin.	Iodine reaction.	Tot'l acid- ity.	Per cent. HCl.
K.	1	Ewald.	60	120	Yes.	Yes.	Violet.	58	0·1682
	2	Ewald.	20	230	No.	No.	Blue.	18	0·0492
	3	Ewald + T. D.	60	80	Yes.	Yes.	Violet.	54	0·1691
	4	Ewald + T. D.	20	200	No.	No.	Blue.	20	0·0471
P. T.	1	Ewald.	60	140	Yes.	Yes.	Violet.	62	0·1714
	2	Ewald.	20	225	No.	No.	Blue.	21	0·0529
	3	Ewald + T. D.	60	125	Yes.	Yes.	Violet.	60	0·1692
	4	Ewald + T. D.	20	190	No.	No.	Blue.	24	0·0593

Table III represents two cases of atony of the stomach, with normal secretory function. In both instances it is shown that taka-diastase somewhat increases the motor function of the stomach without having any influence on the secretion of acid or on the digestion of starches. Thus in case K. T. when the contents of the stomach were removed after sixty minutes the quantity obtained was a hundred and twenty cubic centimetres,

the total acidity 58, and the percentage of hydrochloric acid 0.168; but when taka-diastase had been taken with the breakfast, the quantity obtained was eighty cubic centimetres, the total acidity 54, and the percentage of hydrochloric acid 0.169; in both cases the erythro-dextrin reaction was obtained.

TABLE IV.—*Cases of Subacidity.*

Name.	No.	Diagnosis.	Test breakfast.	Time in minutes.	Quantity in c. c.	Congo reaction.	Phlorogl. vanillin.	Iodine reaction.	Total acidity.	Per cent. HCl.
M. A.	1	Nervous dyspepsia.	Ewald.	60	40	No.	No.	Violet.	14	0·04216
	2		Ewald.	20	85	No.	No.	Blue.	3	.....
	3		Ewald	60	38	No.	No.	Violet.	12	0·02149
	4		+ T. D.	20	75	No.	No.	Blue.	4	.....
C. F.	1	Nervous dyspepsia.	Ewald.	60	50	Yes.	Yes.	Violet.	20	0·06892
	2		Ewald.	20	110	No.	No.	Blue.	2	.....
	3		Ewald	60	48	Yes.	Yes.	Violet.	18	0·06427
	4		+ T. D.	20	135	No.	No.	Blue.	5	.....
P. R.	1	Chronic gastric catarrh.	Ewald.	60	70	No.	No.	Colorless (achroo-dextrin).	10	0·00915
	2		Ewald.	20	120	No.	No.	Blue.	.....	.....
	3		Ewald	60	65	No.	No.	Colorless (achroo-dextrin).	18	0·0572
	4		+ T. D.	20	100	No.	No.	Violet.	4	.....
I. B.	1	Chronic gastric catarrh.	Ewald.	60	35	No.	No.	Colorless (achroo-dextrin).	8	0·00198
	2		Ewald.	20	78	No.	No.	Blue.	.....	.....
	3		Ewald	60	44	No.	No.	Colorless (achroo-dextrin).	17	0·0598
	4		+ T. D.	20	89	No.	No.	Violet.	5	.....

Table IV represents cases of subacidity; of these there are two of purely nervous subacidity (M. A. and C. F.) and two of chronic gastric catarrh (P. R. and I. B.). In the cases of nervous subacidity there is no difference in the secretion of acid or the digestion of starches, whether the taka-diastase had been taken or not. In the cases of gastric catarrh, however, the total acidity and percentage of hydrochloric acid is much increased when taka-diastase is given with test-meal; the digestion of starches is also

further advanced in these cases. Thus, in the case of M. A., nervous dyspepsia, when the contents of the stomach were removed at the end of sixty minutes, the total acidity was 14, the percentage of hydrochloric acid 0.04, with a violet (erythrodextrin) reaction, and when taka-diastase had been added to the breakfast, the total acidity was 12, the percentage of hydrochloric acid 0.214, the starch reaction being also violet.

However, in case P. R., chronic gastric catarrh, the total acidity was 10, the percentage of acid 0.009 when the breakfast was removed at the end of an hour; but when taka-diastase had been added, the total acidity was 18 and the percentage of acid 0.05; in both cases a colorless (achroodextrin) reaction was obtained; in the same case, when the gastric contents were removed at the end of twenty minutes, the total acidity in the first instance is 0, in the second, 4; the reaction for starch was still blue in the first case, but in the second an erythrodextrin (violet) reaction was obtained.

Table V represents the cases of superacidity. In this series of four cases we have one of ulcer and three of simple superacidity. In all we find the excess of hydrochloric acid diminished by the taka-diastase, the motor function of the stomach increased, and the digestion of starches further advanced. Thus in case A. T. (ulcer) when the contents of the stomach were removed at the end of sixty minutes the quantity obtained was sixty cubic centimetres, the total acidity 110, the percentage of HCl 0.39; but when taka-diastase had been taken the quantity obtained was forty-five cubic centimetres, the total acidity 80, and the percentage of hydrochloric acid 0.19; in the first instance a blue (starch) reaction was obtained, while in the second the reaction was violet (erythrodextrin).

In every case of superacidity taka-diastase seems to exert a most remarkable effect upon the digestion of starches, as well as in decreasing the excess of acid and increasing the motor functions of the stomach.

Our next attempt was to determine what effect taka-diastase had in replacing the saliva in gastric digestion.

As is well known from the experiments of Sticker, Schuld, Biernacki, and myself, the saliva plays an important rôle in gastric digestion, in that an absence of salivary secretion not only results in an absence of amyloyisis, but

TABLE V.—*Cases of Superacidity.*

Name.	No.	Diagnosis.	Test breakfast.	Time in minutes.	Quantity in c.c.	Congo reaction.	Phlorogl. vanillin.	Iodine reaction.	Total acidity.	Per cent. HCl.
A. T.	1	Ulcer.	Ewald.	60	60	Yes.	Yes.	Blue.	110	0·3984
	2		Ewald.	20	120	No.	No.	Blue.	30	0·0987
	3		Ewald	60	45	Yes.	Yes.	Violet.	80	0·1984
	4		+ T. D. Ewald	20	95	No.	No.	Violet.	12	0·0171
K. P.	1	Simple super-acidity.	Ewald.	60	75	Yes.	Yes.	Blue.	98	0·2984
	2		Ewald.	20	140	Yes.	Yes.	Blue.	45	0·1724
	3		Ewald	60	61	Yes.	Yes.	Violet.	82	0·2754
	4		+ T. D. Ewald	20	110	No.	No.	Violet slightly.	27	0·0825
A. L.	1	Simple super-acidity.	Ewald.	60	48	Yes.	Yes.	Blue.	112	0·3921
	2		Ewald.	20	142	Yes.	Yes.	Blue.	38	0·0991
	3		Ewald	60	40	Yes.	Yes.	Violet.	92	0·2919
	4		+ T. D. Ewald	20	130	Yes.	Yes.	Violet.	14	0·0392
M. L.	1	Simple super-acidity.	Ewald.	60	95	Yes.	Yes.	Blue.	91	0·2874
	2		Ewald.	20	112	No.		Blue.	27	0·0924
	3		Ewald	60	82	Yes.	No.	Violet.	74	0·2472
	4		+ T. D. Ewald	20	101	No.	No.	Violet.	12	0·0313

that the proteolysis is much retarded. For this purpose a breakfast was utilized, consisting of white of egg and starch solution, an amount equal to two hundred and seventy cubic centimetres. The starch solution consisted of one hundred to two hundred cubic centimetres of a four-per-cent. solution of starch—that is, four to eight grammes of starch boiled with one hundred and fifty to two hundred and fifty cubic centimetres of water and twenty cubic centimetres of raw egg albumin then added (represented by 1 e. 250 st.). In the first series of experiments the breakfast was introduced through the stomach-tube after previous lavage. During the following half hour the saliva was collected in a cup, and at the end of this time the gastric contents were expressed. The patient was now allowed to rest for fifteen minutes.

The stomach was then again washed out and the same quantity of a similar breakfast, with the addition of two grains and a half of taka-diastase, introduced through the tube. After half an hour the gastric contents were again

TABLE VI.—*Effect of Taka-diastase on the Starch Digestion in Normal Cases and in Nervous Dyspepsia with Normal Secretory and Motor Function.*

Name.	No.	Test break- fast.	Antin. c.c.	Congo reac- tion.	Phlorogl. vanillin.	Iodine reac- tion.	Total acidity.	Per cent. HCl.	
T. J.	1	1 E. + 250 st.	75	Weak blue.	No.	Strong blue.	12	0·0378	Taken through tube.
	2	1 E. + 250 st. + 2½ gr. T. D.	50	Strong blue.	Reac- tion.	Vio- let.	40	0·1246	Taken through tube.
F. K.	1	1 E. + 250 st.	60	Weak blue.	No.	Strong blue.	18	0·0492	Taken through tube.
	2	1 E. + 250 st. + 2½ gr. T. D.	32	Strong blue.	Reac- tion.	Vio- let.	46	0·1327	Taken through tube.
T. M.	1	1 E. + 250 st.	60	Weak blue.	No.	Blue.	14	0·0392	Taken through tube.
	2	1 E. + 250 st. + 2½ gr. T. D.	20	Strong blue.	Reac- tion.	Vio- let.	38	0·1279	Taken through tube.

removed and compared with those obtained in the previous experiment. As daily variations in the motor and secretory functions of the stomach occur, the two experiments, as in all the other cases given above, were made on the same day. The character, quantity, and temperature of the two breakfasts were always the same in those cases in which comparisons were made. With the starch breakfast it is easy to tell to what degree the breakfast has been acted upon by the taka-diastase. The experiments were made upon three persons with perfectly normal motor and secretory functions. In every instance the taka-diastase manifested a markedly beneficial action upon the gastric digestion. The total acidity and percentage of hydrochloric acid were markedly increased under its use, the motor function much improved, and the digestion of starches further advanced.

Thus in the case of T. J. the quantity of contents obtained at first was seventy-five cubic centimetres free hydrochloric acid, of a strong blue (starch) reaction, a total acidity of 12, and percentage of acid 0.03; when, however, the taka-diastase had been added to the break-

fast the quantity was but fifty cubic centimetres, containing free hydrochloric acid with a violet (erythro-dextrin) reaction, of a total acidity of 40 and percentage of acid 0.12.

The taka-diastase therefore seems to an extent not only to replace the saliva in converting starches into sugar, but serves another function of the saliva in promoting the secretory as well as the motor function of the stomach.

From these experiments it may be concluded:

1. That taka-diastase exerts no influence under normal conditions upon gastric digestion nor upon cases of nervous dyspepsia with normal motor and secretory functions.
2. That in cases of motor disturbances of the stomach with normal secretory functions, such as atony, taka-diastase increases the motor action without in any way influencing the secretory function or the digestion of starches.
3. That in cases of subacidity taka-diastase acts differently, according to whether there is a catarrh or a nervous dyspepsia. In nervous cases it has no effect whatever upon digestion, while in cases of catarrh it appears to have a tendency to increase the flow of acid and promote the digestion of starches.
4. That taka-diastase exerts its most favorable influence in cases of superacidity. It not only promotes the digestion of starches in these cases but diminishes the excess of acid and increases the motor function.
5. That taka-diastase in a great measure replaces the saliva when this secretion is diminished or absent. It then not only digests the starches in the stomach, but serves the other function of the saliva in stimulating the gastric secretion and therefore promoting the proteid digestion.

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